


Welcome to the SAM-TWG


Objectives of SAM-TWG meeting, 7-11 Nov. 2011, Ethiopia:

- Identify current spatial analysis and modeling challenges in the different basins;
- Get an overview of approaches and which/how they adjust existing methods to the specific basin challenges (linking socio-economic/institutional data to the bio-physical world, adjusting hydrological models to the particular basin dynamics) ;
- Create a network of scientists to share knowledge, work together and help each other;
- Come up with a list of cross cutting issues to be taken forward during the IFW3.

Objectives of the IFW3 SAM-TWG session:

- Bring together and engage potential members /participants and beneficiaries of the SAM TWG;
- Present the outcomes from the first SAM workshop in the Blue Nile Basin;
- Identify topic working group objectives relevant to the broader CPWF community and mechanisms to maintain the momentum of the group;
- Initiate a ‘formal’ SAM network using e.g. mailbase, wiki etc.

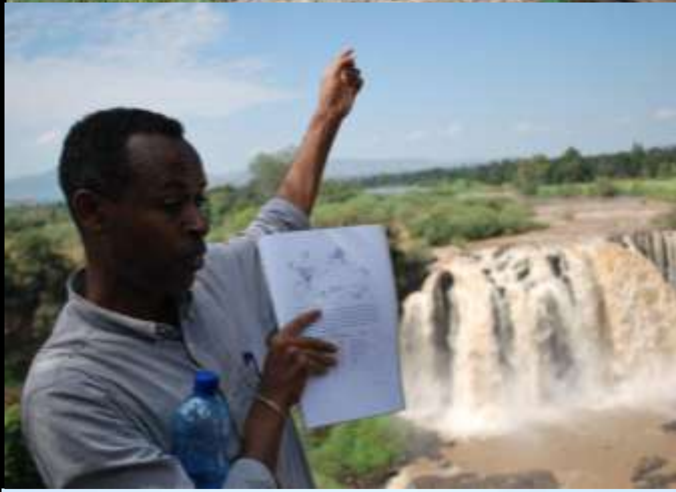


SAM in ET: 2 day field trip to the Lake Tana Area – source of the Blue Nile

Explored the landscape and had a lot of opportunities to discuss processes in context, comparing issues from different CPWF basins

e.g. visited rainfed and irrigated areas (formal and community/traditional); observed hydropower (Nile falls and LakeTana) and environmental flow allocations; livestock, common land and deforestation issues; landscape processes and watershed management first hand; hydro-met installations

+ dead dog ☠ *and Jumbos* ☺



2-day Workshop in Addis Ababa:

- Presentations and discussion on ‘state of the art’ in hydrological, spatial, economic/PES modelling from basin teams and invited experts

- Review of current basin modelling situation

Identified commonalities, challenges and potential solutions with view to cross-basin fertilization



Now:

1. Report on the modelling and spatial analysis techniques used in the BDC's

2. Presentations on 3 cross-cutting themes prioritized by the SAM group in Addis:
   - XLRM and Scenario Development
   - Landscape Dynamics
   - Data and Uncertainty

3. Group discussion and feedback

4. Other issues?

… more on your presentations on Wednesday share fair at ***<u>1 pm</u>****….*

Review of Modelling in the BDC watersheds

Manuel Magombeyi, Natalia Uribe, Solomon Seyoum

Modelling Efforts and Purposes

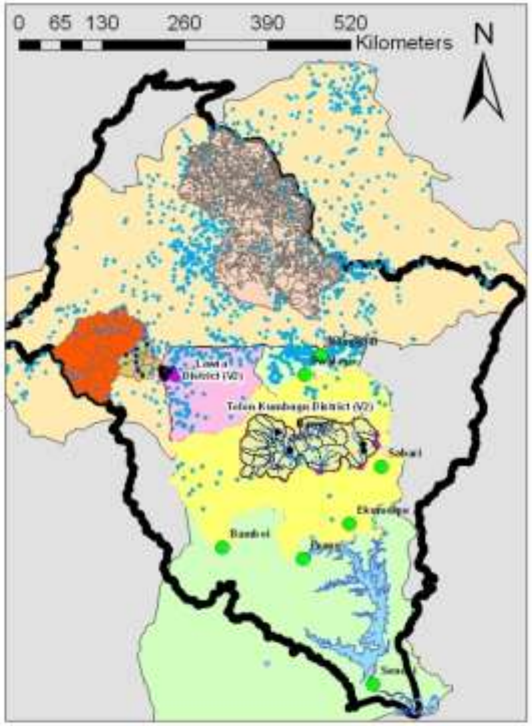
- **Hydrological and Hydrodynamic Modelling**
  - Water availability and quality response to management changes
  - Soil erosion and land degradation
  - Extreme events and flooding extents
  - Salinity and saline intrusion
- **Productivity Modelling**
  - Water productivity of farming and production systems
  - Identification of 'hot-spot' areas for management interventions
  - Productivity gaps and potentials
- **Water Resources Modelling**
  - Optimal water allocation for various sectors and users
  - Integrated assessment of water sources and demands
  - Conflict resolution

Modelling Efforts and Purposes cont.

- **Socio-economic modelling**
  - Capturing social responses to drivers of changes and technological interventions
  - Cost-benefit analysis of alternative options
  - Attribution of livelihood improvements
- **Environmental Modelling**
  - Ecosystem functions versus consumptive uses
  - Environmental impacts of management options and drivers
- **Integrated Impact Modelling**
  - Trade-off analysis of options and scenarios
  - Provision of evidence for decision making
  - Holistic assessments of impacts and vulnerability

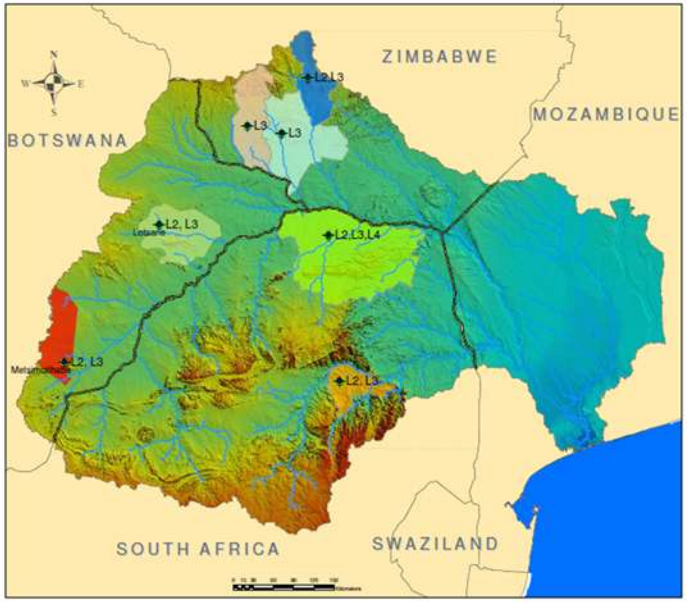
Examples of Models Adopted:

Category	Models	Basins
Hydrology	SWAT VMod Bayesian Tool Mike/-SHE/-11	Andes; Limpopo; Nile; Volta Mekong Limpopo Ganges
Productivity	Modified Turc's Index AquaCrop LPJmL MaxEnt	Andes Nile Andes
Water Resources	WEAP MODSIM + CSUDP	Andes; Nile; Volta Mekong;
Environment	InVEST Env. Simulator and Scenario Analyzer	Volta; Nile Andes
Socio-economic	ABM (COMMONS) Tradeoff Analysis	Volta Andes
Integrated Impact	ECOSUAT InVEST + ABM	Andes; Nile Volta



Volta

Biggest challenges: scale issues; data scarcity; characterizing sedimentation , erosion and population pressure; uncertainty – how to deal with error propagation from one model to the next; linking SWAT & WEAP



Limpopo

Challenges data scarcity in ungauged basins (different levels of data in contributing countries); localized P & Q; role of small reservoirs; identifying & characterizing (successful) interventions/RMS.

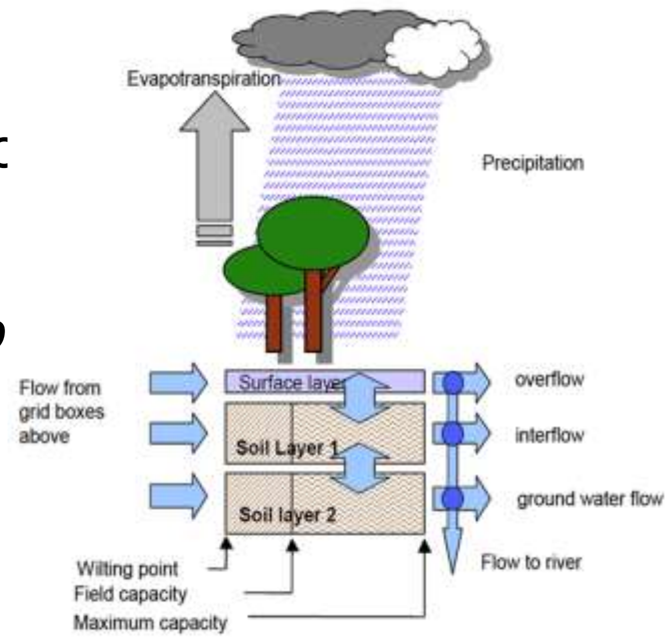
Nile

Challenges: data scarcity (Q, P/MET and sediment) and uncertainty; model initialization from small sub-catchment to whole basin; properly incorporating landscape and landuse processes – how to model scenarios?

Mekong

Modelling can be considered as macro scale scoping of multiple use potential c reservoirs

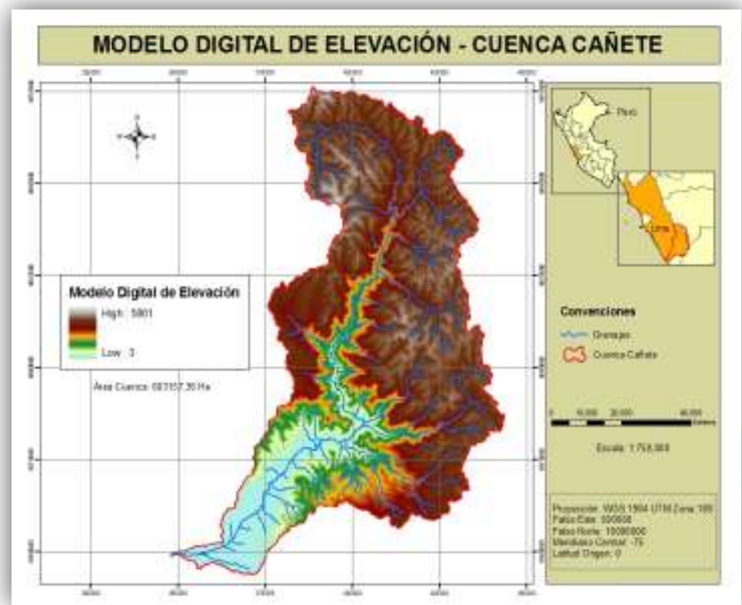
- Hydrological model (VMod) *similar to SWAT*
- Dynamic programming tool (CSUDP) hydropower operation
- Decision support system (MODSIM)



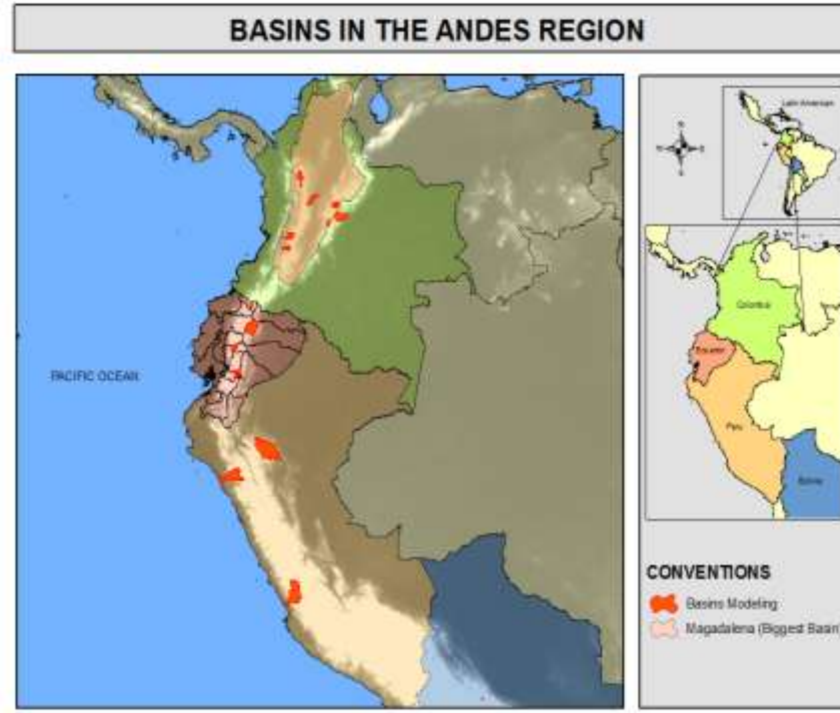
Andes Basins

The CPWF works in +/-10 small basins in the Andes region covering four countries: Bolivia, Peru, Ecuador & Colombia.

Challenges: Data scarcity, snow melt issues, crop growth simulation, calibration of the model using new sensitivity and uncertainty processes.



Andes Basins



AN1
Watershed not selected- pending

AN2
Fuquene (Colombia): Water quality degradation
Fomeque (Colombia): Water scarcity, water allocation.
Quijos (Ecuador): Conflict between various water use sectors.
Canete (Peru): Under productive irrigation systems.

AN3
Coello (Colombia): Paramo conservation, water supply for Ibague, mining pressures
Putamayo (Colombia): Paramo conservation, social instability, high poverty levels.
Santa (Peru): upstream-downstream conflict, important hydropower production.
La Paz/El Alto (Bolivia): Hydrologic change, rapid urbanization, inter-basin water transfers.

SPATIAL MODELLING IN THE CPWF BASINS

ANDES, GANGES, LIMPOPO, NILE & VOLTA BASINS

REVIEW FROM SAM TWG MEETING IN ADDIS

Frank O. Annor, An Notenbaert, Andrew Nelson, Charlotte Macalister
Catherine Pfeiffer, Manuel Magombeyi, Nowsher Ali Sarder …

How is it being done?? Framework! ★

Benefit Sharing Mechanism & Targeting and Scaling Out

Characterisation of RWM ≈AWM Practices based on protocols

- **Biophysical**
- **Socio-economic**
- **Environmental**
- **Institutional/Political**

Evaluation of Interventions

MCAs, PGIS, Games

Mapping Recommendation≈ Extrapolation domains

Assessing Hydrological, Socio-economic and Environmental Impacts

- **SWAT**
- **WEAP**

DSS≈DST to scale out interventions or BSM

Bayesian Model

Challenges

- Application of field surveys (reluctance of locals to participate in more surveys
- **Access to** and **availability** of **reliable** data
- How to identify and weigh suitability & evaluation criteria?
- How to come up with "main constraints and opportunities" for objective functions?
- Few success/ failure cases documented

Picture: courtesy Issa Ouedraogo

XLRM framework and scenario development

Marisa Escobar, An Notenbaert, David Purkey

As model development and construction on a range of CWPF project has advanced substantially, attention is now turning to the development of scenarios that will form the basis of upcoming analysis. Key issues to consider are:

- How will the environmental and social context change?
- Which land and water management strategies should we analyze?
- How should we compare different strategies?
- How should we best configure our modeling tools to answer the preceding questions?

The XLRM Framework is a Potentially Useful Tool

X: exogenous factors	**L: levers**
Scenarios Uncertainty *Outside the control of actors*	Policy and management options Strategies *Actions that can be taken*
R: Relationships	**M: Performance Measures**
Models *How factors interact*	(testable) outcomes *Determining the success*

$$XL \xrightarrow{R} M$$

Implementation of XLRM

- Define the spatial scope of the analysis/modeling
- Identify key actors/stakeholders within the spatial domain and organize participatory elicitation of key elements of X, L, and M.
- Capture key uncertainties, management strategies, and performance metrics in the modeling framework developed for the project.
- Produce an ensemble of model runs (R) based on the following experimental design: $X_i L_j$ ----R----> $M_{i.j}$
- Evaluated the matrix of performance metrics to identify promising strategies.

La Paz-El Alto, Bolivia – Min. of the Env. and Water

(X)	(L)
Growth of city of El Alto Change in land use Social conflict for water use Climate change: rain season change, glacier retreat, increase in temperature Industrial, mining pollution Lack of law to categorize water bodies (so far, 34 draft versions of law)	Project to increase storage capacity Plan to diagnose and water management in watershed Sectorial table for irrigation National watershed plan to increase capacity and monitoring Improving wastewater treatment Master plan for water supply
(R)	**(M)**
They are interested in being part of the process and generate information with WEAP and AguaAndes.	Hydrologic balance Water distribution Explore new sources of water Mechanisms to compensate communities Quantify irrigation water Mechanisms to implement the law Water bodies categorization Wastewater discharge Appropriate land use Water quality



LANDSCAPE DYNAMICS IN THE NILE BASIN

Catherine Pfeifer

Tammo Steenhuis

Nile in Cairo, Egypt

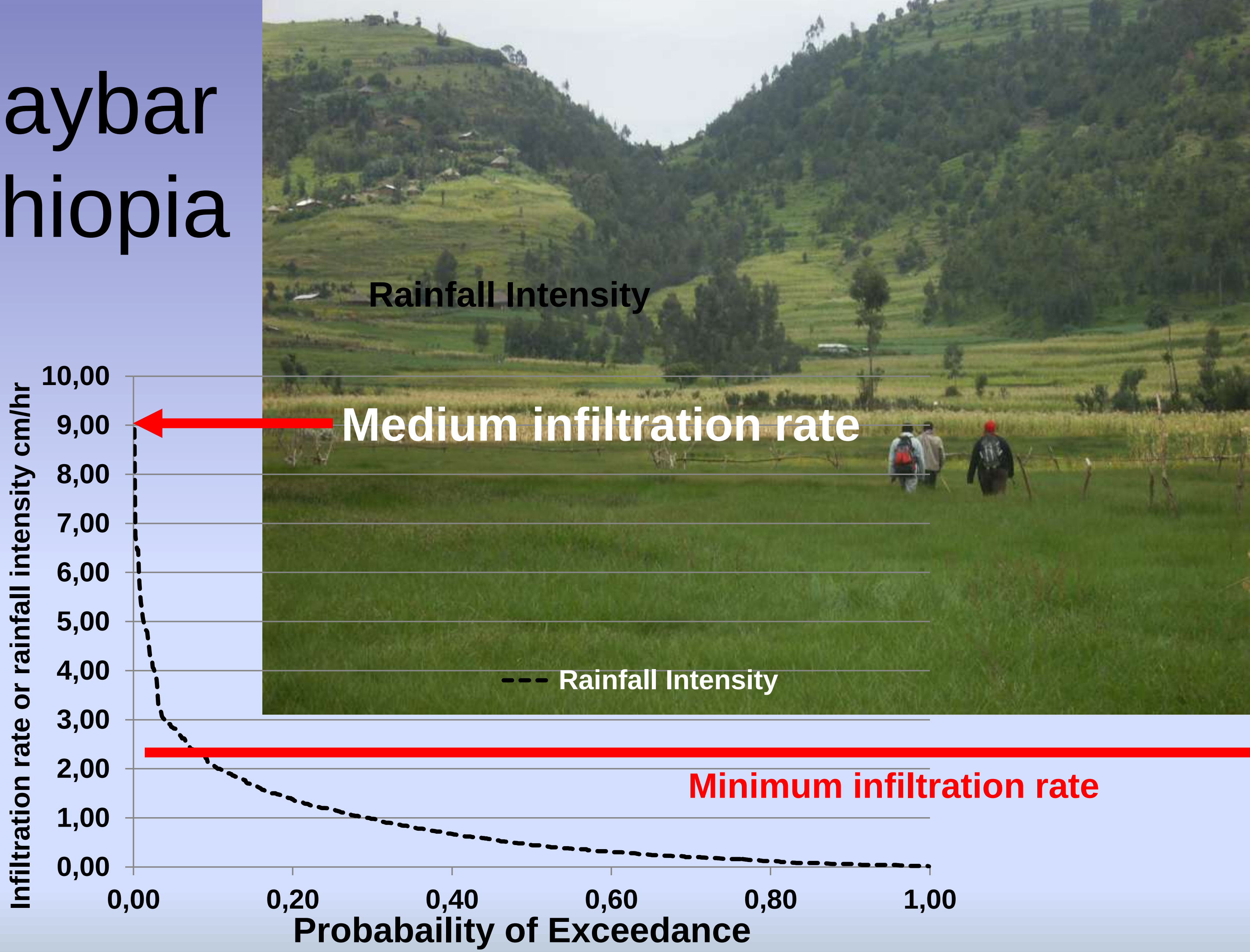
85% originates from the Ethiopian highlands

The Ethiopian highlands

Runoff and Erosion is spatially distributed in the landscape

Why is that?

Maybar Ethiopia



RUNOFF PLOTS (MAYBAR)
SURFACE RUNOFF DECREASES WITH STEEPNESS

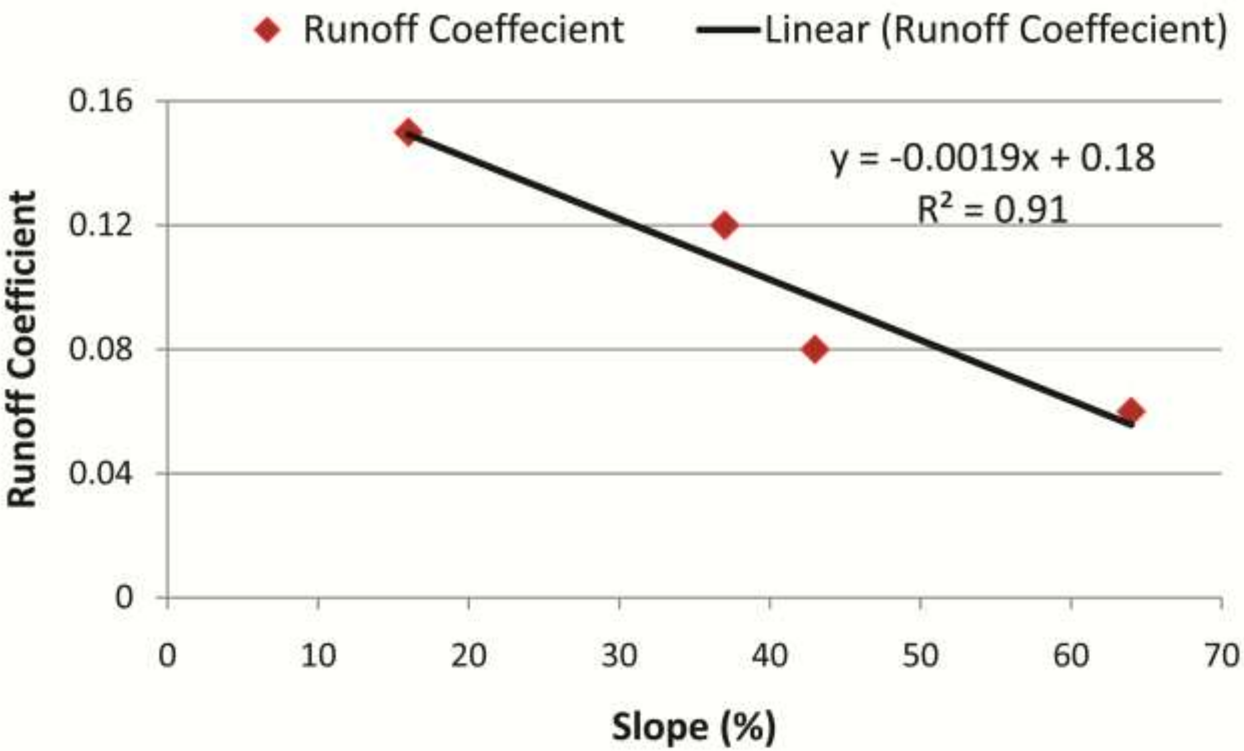
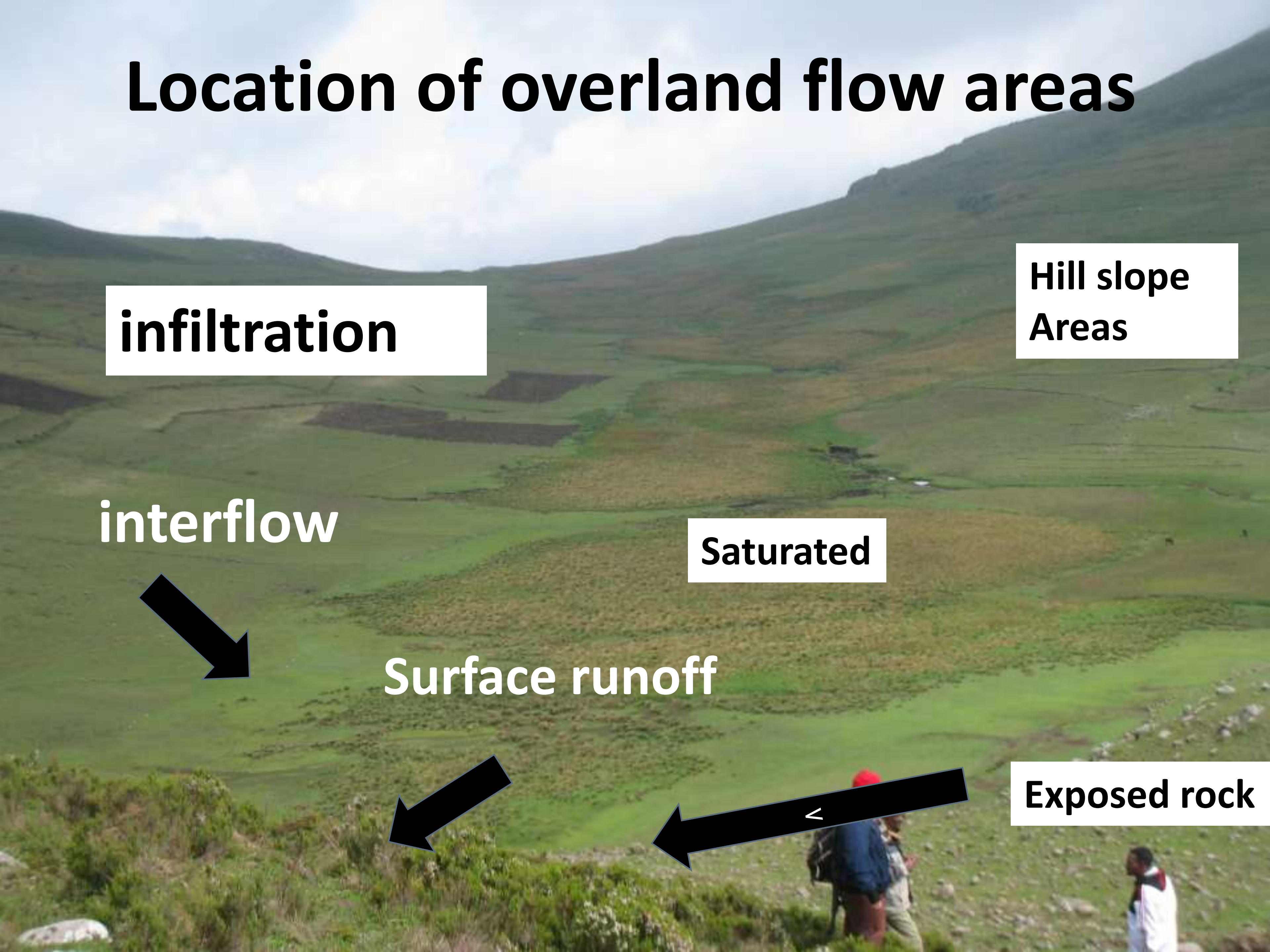


Figure 6

Location of overland flow areas




Forest steep slopes
Water shortage
Crops intermediate slopes
intermediate water tables
Grass lower slopes – high water table

SAME FIELD CHARACTERISTICS, TWO DIFFERENT LAND MANAGEMENT

CONCLUSIONS

- Adoption of rainwater management practices depend on bio-physical and socio-economic factors
- The type of practice is related to landscape position and related spatial distribution of surface runoff
- Geo-referenced data is crucial to integrate different scientific approaches and system elements.

Data and Data Uncertainty

Dan Fuka, Wouter Buytaert

Data Goals

- **Data for modelling**
  - **XLRM (Relationships/Model)**
    - **Model Development**
    - **Scaling up/out**
  - **XLRM (Levers)**
    - **Site characterization**
    - **Management practice planning**
- **Impact assessment / How did we do?**
  - **XLRM (Metrics)**
    - **Farm income**
    - **Power production**
    - **Sediment**
- **Generate knowledge**

Data Collection

- **Pre-review of what is available publicly as well as within the project areas**
- **Types of data necessary (social/biophysical)**
- **Local expert knowledge**
  - **Farmer participation and knowledge**
- **Accuracy/Reliability/Uncertainty**
- **Gaps in data**
  - **Temporal**
  - **Spatial**

Uncertainty in Field Surveys

XLRM (eXternalities)

- Asking farmers how many cattle they have may give different answers depending how you ask the questions
  - How many cattle you have?
  - How many cattle do you need vaccinations for?

Spherical Cow

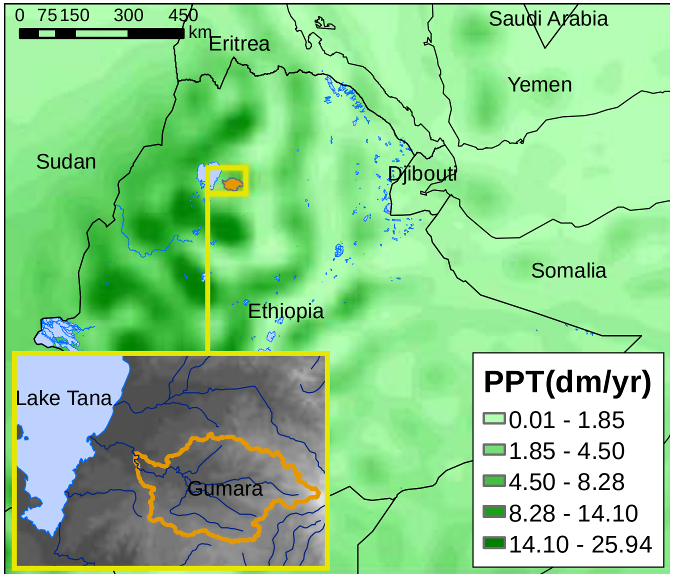
Uncertainty in Forcing Data

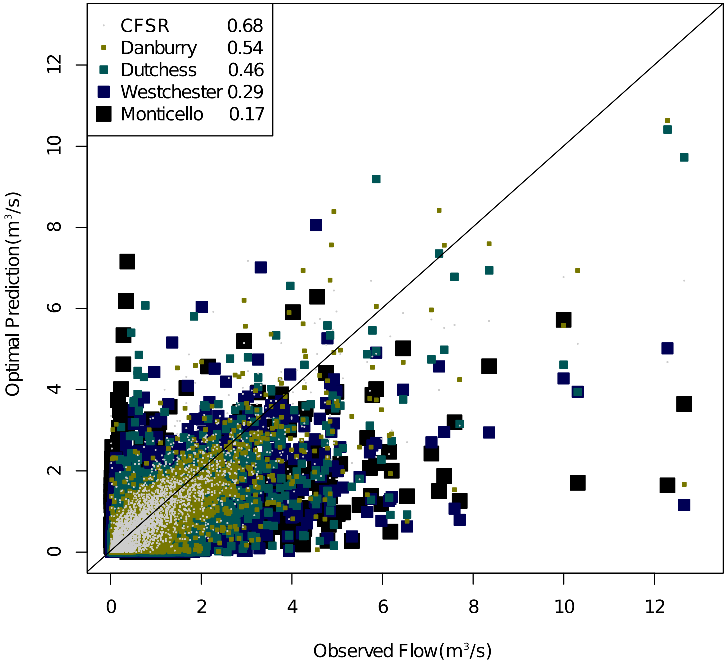
XLRM (eXternalities) cont.

- Precipitation and Climate
  - 2 studies
  - similar data sets
  - significantly different results

CFSR Study

- Climate Forecast System Reanalysis (CFSR)
  - Hourly 1979 – Today
- Closest Weather Stations.
  - Closest Stations in Ethiopia
  - Distance vs Performance in US
- Hydrologic Model Performance Relates to Weather Data Quality
  - SWAT
- Variables
  - PPT, as well as Max and Min Temperature.

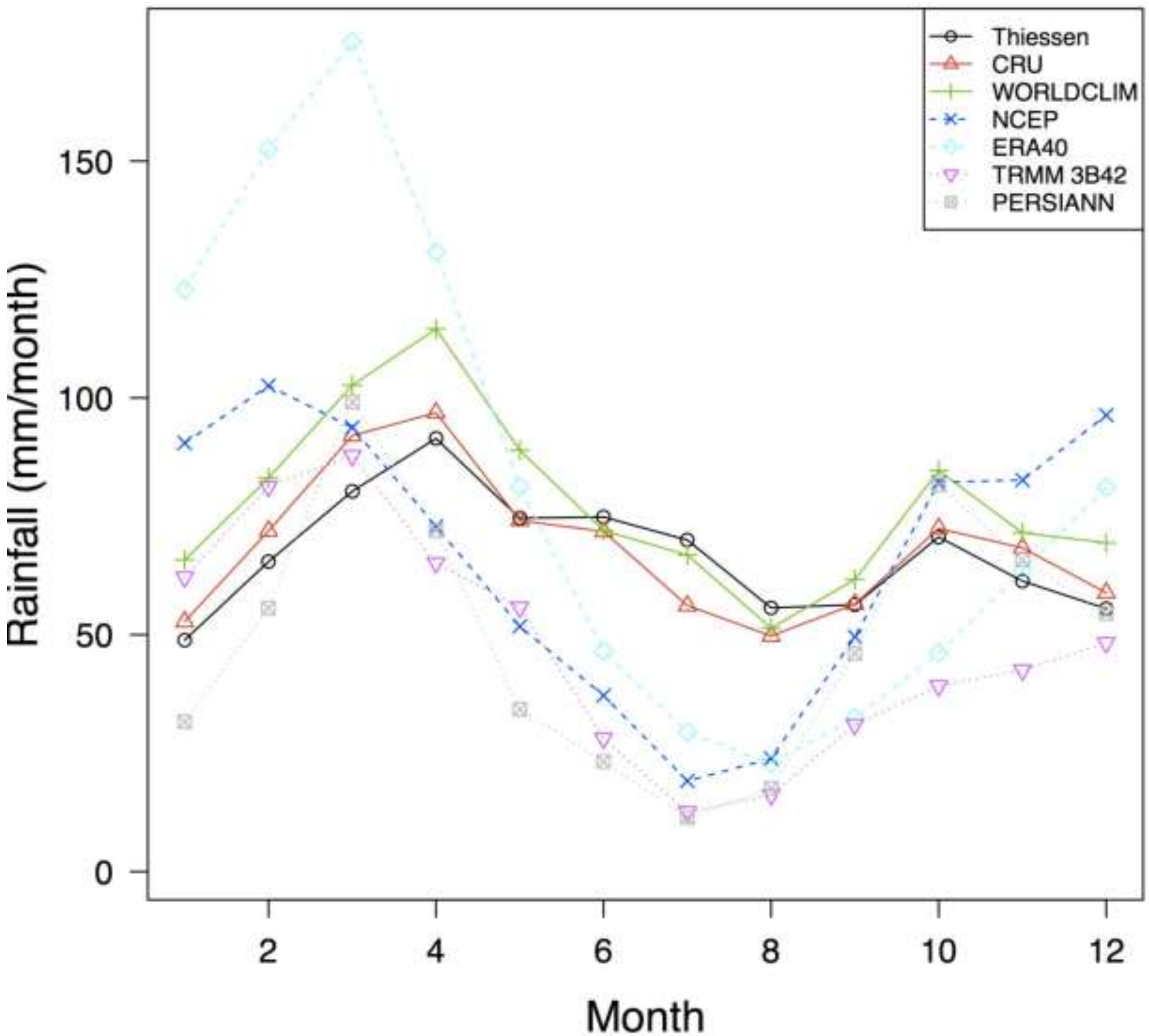




Location	Watershed Area (km^2)	Best Met Distance (km)	Best Met NSE	CFSR NSE
Cross River	44	13	0.54	0.68
Town Brook	37	0/3	0.52	0.63
Gumara	1200	0/30	0.68	0.70

Uncertainty in Precipitation Products

Before you get excited about previous study



Average monthly precipitation, Paute basin, Ecuador for 7 possible solutions.
Ward et al. 2011

Data Sharing and Availability

XLRM (eXternalities)

- IP of datasets
  - Corporate or Government owned
  - Investigator withholding
  - Politics
- Funding of public repositories
- Documenting Data Quality

Gaps in data

XLRM (eXternalities)

- **Continuity in data collection**
- **From current to future requirements**
- **Strategies to fill gaps**
- **Disaggregating global data sets**

SAM Inspirations

- **Sharing (basins/projects)**
- **Institutional awareness**
  - **How can we help each other with similar projects**
- **Work with groups from Texas and the Netherlands (ISRIC) to develop soil data for SWAT and other models in appropriate formats**
- **Work with groups from Texas and Cornel to have a world dataset of hourly, daily & monthly weather data at 0.5 degree (38km) in the format needed by SWAT, WEAP and other models**
  - **Any basin in world**
  - **30yr hourly time series**
- **Data comparisons by groups from Imperial College and Cornell to grasp uncertainty in forcing data and modelling systems**

Group discussion in 3 groups:

1. XLRM and Scenario Development
2. Landscape Dynamics
3. Data and Data Uncertainty

- How relevant are these challenges to your basin?
- 30 minutes;1 reporter from each group.

Group feedback:

XLRM framework and Scenario Development

Scenarios: 'stories about the future'; 'tools to examine alternatives'.

- Different tools including visioning exercises, story-telling
- Important to included different stakeholders perspectives
- Tension between scenarios that are accepted by stakeholders vs those which examine extreme alternatives

Models:

- All involve assumptions which can be subjective
- XLRM can be an entry point to developing scenarios

Landscape Dynamics – SWAT

What is new?

- Importance of relationship between runoff and topography (in SWAT)

Key message for African context?

- Can use less complicated models to explain hydrology
- Curve number is not applicable to monsoonal climates

<u>Landscape Dynamics – </u>Linking biophysical and human

Mekong – LU optomization for farm systems

L1/V1 – Bayesian approach e.g. farmer typology

Nile – MCA; poverty mapping techniques for adoption

Bayesian approach – capable of describing what you don't know and to integrate beliefs; dynamic.

Statistical approach – how to make the approach dynamic? Can assess assets over time, to look at hydrological indicators; ' homologue' approach

Data and Data Uncertainty

Key issues in each basin. E.g.

Mekong – some data held by private companies; seasonal representation can be lacking;

Andes – evolved form local based now moving towards global data sets (RS); model types include policy-maker and science driven

Limpopo / Nile – data availability and resolution

Opportunities:

Increasing use of free global data RS e.g. G-earth

Data sharing between basins

Can we improve communication of available data and share approaches

During CPWF phase 1 a database (IDIS) was created – can this be accessed?



SAM poster presentations 1pm Share fair – OlympiaB

Thanks to Andes – July 2012!

Help us to make the group help you!